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Grass rusts of unusual structure*

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(WITH TWO TEXT FIGURES)

The leaves of species of *Olyra* belonging to the tribe Paniceae and of species of bamboos are frequently much alike in form and physical characters, although systematists place the genera nearly at the extremes of the grass series. The resemblances are often so great that only an experienced agrostologist can feel sure of their identity when not accompanied by inflorescence. It is not surprising, therefore, that the rusts on these genera, as well as their hosts, should have been confused. Thus *Uredo Olyrae* P. Henn., described in 1904, to which true *Olyra* rusts have been referred, has recently been found to be on some species of the bamboo genus *Arundinaria*, and *Uredo ignava* Arth. on the genus *Bambos* has only recently been separated from material formerly placed with paniceous rusts.

Not only is there a curious resemblance between the leaves of these two groups of hosts, but also an equally interesting resemblance between some of the rusts that inhabit them. This was first noticed in the uredinia having delicate incurved paraphyses and spores that are more or less thin-walled and colorless. Later it was found that the presence or absence of these weakly differentiated paraphyses is not by itself an important diagnostic character, as the forms called *Uredo paspalicola* without paraphyses and *U. Stevensiana* with paraphyses have been shown to be only extremes of one species having all degrees of intergradation.

In the study of this sort of rusts it became more and more necessary to use a razor and make sections of the sori in order to be surer of their structure. In this manner the paniceous species, *Puccinia tubulosa*, *P. inclita*, and *P. imposita*, were segregated and gradually circumscribed from what had been lumped as *P. sub-*

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* Reprints may be obtained by application to the Botanical Department, Purdue University Agricultural Experiment Station, Lafayette, Indiana, under whose auspices the studies here reported were carried out.

striata. Then the telia were found in *P. Chaseana* on a host belonging to a family preceding the Paniceae. The final triumph came in the discovery of telia with the much-studied form, *Uredo pallida* (*Puccinia pallescens*) on *Tripsacum*, a grass belonging to the tribe Maydeae. These telia would doubtless not have been discovered through the usual method of examination by scraping the spores from the leaf with a scalpel. Sections show the sori to be small, indehiscent, and filled with pale, compacted spores (FIG. 2*A*) that are thin-walled and practically without pedicels. Many of the teliospores are three-celled, especially toward the center of the sorus. The whole appearance of the telia and teliospores is quite unlike that of the ordinary grass rusts, and reminds one of those in the group of melampsoraceous rusts represented by *Phakopsora*.

Even with this experience the telia of still another species of rust on *Olyra latifolia* were passed over for a time. The uredinia had been referred to *Puccinia deformata* Berk. & Curt., on the same host, a species with prominent telia, known for over fifty years, but with no described uredinia.* Thin-walled, nearly colorless urediniospores, surrounded by incurved paraphyses, were found, and on the same leaves were discovered telia by the sectioning method. So unusual was the appearance of these telia, however, that they were tentatively referred to the genus *Phaksopsora*, and might have remained there longer had the grasses been known to harbor species of this genus. It was then thought there might have been an error in determination of the host, and that it was a bamboo, instead of the *Olyra*. After much study the following description of a new species of rust was evolved, and incidentally the true urediniospores of *P. deformata* were found.

Puccinia phakopsoroides sp. nov.

II. Uredina amphigenous, small, round, cinnamon-brown, early naked, ruptured epidermis inconspicuous; paraphyses peripheral, incurved, clavate, 10–12 by 35–50 μ, the wall cinnamon-brown, 1 μ thick, usually thickened up to 2–3 μ on the convex side; urediniospores ellipsoid or broadly obovoid, 19–26 by 27–35 μ; wall slightly brownish or nearly colorless, 1–1.5 μ thick, closely echinulate, the pores very indistinct, probably 2 and equatorial.

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* See Arthur & Johnston, Uredinales of Cuba. Mem. Torrey Club **17**: 136. 1918.

III. Telia hypophyllous, scattered, squarish-oblong, 0.5–1 mm. long, covered by the epidermis, compact with the spores adhering laterally, brownish-black due to discolored host-tissue; teliospores 1-, 2- or 3-celled, short-cylindric, 8–14 by 24–39 μ, rounded or depressed above and below, somewhat constricted at septa; wall pale-brown or colorless, smooth, thin, uniformly 1 μ or less in thickness, but with an outer colorless layer swelling in in water to 2–3 μ above, demonstrable by staining; pedicel wanting or extremely short and colorless.

On *Olyra latifolia* L., Mayagüez, Porto Rico, January 30, 1890, II, III, *A. A. Heller 4443*, communicated by P. L. Ricker; San German, Porto Rico, December 12, 1913, II, *F. L. Stevens 5849, 5855;* Manati, Porto Rico, July 2, 1915, II, *F. L. Stevens 7700;* Soledad, Cienfuegos, Cuba, November 7, 1915, ii, *J. R. Johnston 247;* Isle of Pines, Cuba, February 20, 1916, II, *Britton, Britton & Wilson 14648;* Ceballos, Cuba, March 24, 1916, II, *J. R. Johnston 509;* Guantanamo, Cuba, February 7, 1918, II, III, *J. R. Johnston 1028* (TYPE).

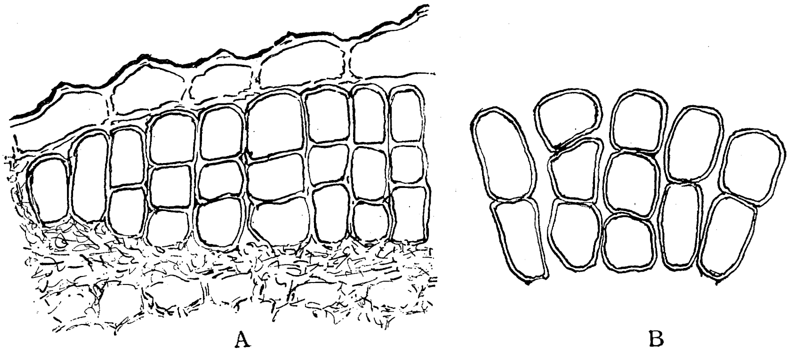

FIG. 1. *Puccinia phakopsoroides: A*, section showing part of a telial sorus and the adjoining host tissues; *B*, teliospores after treatment with potassic hydrate. × 625 diameters.

There is a marked gradation evident in some tropical rusts, especially the grass rusts as indicated above, toward the production of thin-walled, pale or colorless spores. In the uredinia these spores are frequently accompanied with a fringe of incurved, hyphoid paraphyses. In the telia the spores are small and often compacted, long remaining covered by the epidermis. As usual in subepidermal forms, these teliospores have short pedicels.

Puccinia phakopsoroides illustrates an extreme development in this general direction, most strongly seen in the telia. Drawings of the telial sorus of both *P. phakopsoroides* and *P. pallescens* (FIGS. 1*A*, 2*A*) show the spores as cylindrical bodies pressed very closely together, as if restricted by the unyielding epidermis. The spores appear to be less highly differentiated than in most grass rusts, having a variable number of cells with a quite uniform wall, and a pedicel so short and delicate that one is left in doubt whether there is a truly pedicellate cell, or only a hyphal connection with the hymenial layer of the fungus.

Sections of the sorus give a superficial resemblance to forms of *Phakopsora*, especially in the denseness, the pale color and translucency, and in the evenly disposed, vertical rows of apparently similar cells, more cells being in a row at the center of the sorus than at the edge. In *Puccinia* each row of cells forms a single spore; in *Phakopsora* there are as many independent spores as there are cells. In *P. phakopsoroides* this resemblance is emphasized when the sections are treated with potassic hydrate, and the spores pressed out of the sorus (FIG. 1*B*). The cells then seem

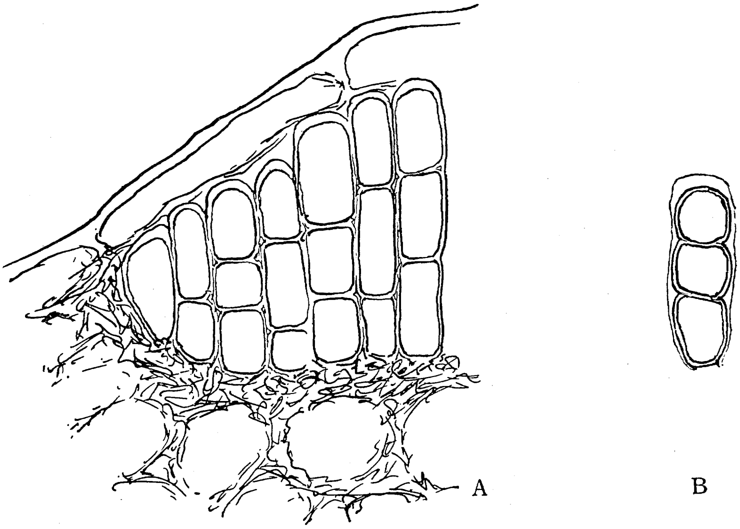

FIG. 2. *A*, section showing part of a telial sorus of *Puccinia pallescens*, with adjoining host tissues; *B*, a teliospore of *P. phakopsoroides* treated with eosin to show the outer hygroscopic layer of the spore-wall. × 625 diameters.

to separate and appear like one-celled spores in rows, the enveloping outer layer of the spore-wall being invisible, having been swollen and partly dissolved by the potash. However, if sections are stained with eosin, and the spores pressed apart, it is easy to discern a delicate outer layer of wall, swelling in water and becoming thicker above than at the sides of the spore (FIG. 2*B*). The presence of this hygroscopic layer explains why the cells remain in chains, even after macerating in potash, and doubtless why the cells adhere laterally with so much tenacity in an ordinary mount. In *P. pallescens* there is no such hygroscopic layer.

In the above paragraphs comparison has been drawn especially between three tropical rusts of similar but extreme development, which are found on grasses having slight relationship, according to the classification used by modern agrostologists: *Puccinia pallescens* on *Tripsacum*, the first genus in Hitchcock and Chase's "Grasses of the West Indies," *P. phaksopsoroides* on *Olyra*, the fifty-second genus in the same work and *Uredo ignava* on *Bambos*, the one hundred and tenth and last genus of that work. The telia of the last species have not yet been found, but it is confidently believed that when discovered they will resemble those of the other two species named.

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